However, in the electrostatic chucks of any types, in order to remove the annular electrodes disposed in the recess of the electrode or the recess groove, a heat treatment must be conducted to break down an adhesive layer that fixes the annular electrode within the recess or the recess groove, or the annular electrode must be removed by mechanical means. Thus, there are many cases in which it is difficult to disassemble the bipolar electrostatic chuck that has been assembled once. Also, the configurations of the surfaces of the separated first electrode and main member onto which the second electrode and the electrode member had been fixed are complicated. As a result, a polishing process or an oxide coating reproducing process necessary for recycle is complex and diverse, and a large number of processing steps are required in order to use the electrostatic chuck again, thereby increasing the reproduction costs. Also, the reproduced oxide coating may lack the coating intensity on the boundary surface of the reproduced electrode, thereby leading to such a problem that the durability is deteriorated. In addition, even if various reproducing processes are conducted, the electrode that has been subjected to the respective processing required for reproduction increase the amount of reduced dimensions as compared with the electrodes that have not yet been reproduced. As a result, there arises such a problem that the electrode

cannot be again used in the semiconductor manufacturing device even if the electrode is assembled as the electrostatic chuck again. For that reason, even if the electrostatic chuck is recycled, the number of times of reproductions is extremely restricted, and there are many cases in which it is substantially difficult to recycle the used electrostatic chuck.

DISCLOSURE OF THE INVENTION

Under the above circumstances, as a result of earnestly studying a bipolar electrostatic chuck that can be manufactured easily as compared with the conventional bipolar electrostatic chuck, can be readily separated and assembled after having been used, and can be efficiently recycled, the inventors of the present invention have completed the invention that solves the above problem by forming a sample adsorption surface that absorbs a sample by respective electrode members mounted onto a mounting surface of a chuck main body through an adhesive layer, and enabling the respective electrode members to be readily separated from the mounting surface after use.

Accordingly, an object of the present invention is to provide a bipolar electrostatic chuck that is easier in manufacture than the conventional bipolar electrostatic chuck,

can readily separate the chuck main body and the electrode member which constitute the electrostatic chuck from each other, and can effectively realize the recycle.

That is, the present invention provides a bipolar electrostatic chuck, comprising: a chuck main body having a mounting surface; an annular electrode member which is formed in an annular configuration with a center opening and is fixed onto the mounting surface; an inner electrode member which is disposed at a given clearance from the annular electrode member within the center opening of the annular electrode member and is fixed onto the mounting surface; and an outer electrode member which is disposed at a given clearance from the annular electrode member outside of the annular electrode member and is fixed onto the mounting surface, wherein, at the time of assembling, the annular electrode member, the inner electrode member, and the outer electrode member are fixed onto the mounting surface through an adhesive layer, respectively, the inner electrode member and the outer electrode layer constitute a first electrode, and the annular electrode member constitutes a second electrode, and after use, the annular electrode member, the inner electrode member, and the outer electrode member can be separated from the mounting surface.

Also, the present invention provides a bipolar electrostatic chuck, comprising: a chuck main body having a

mounting surface; an annular electrode member which is formed in an annular configuration with a center opening and is fixed onto the mounting surface of the chuck main body through an adhesive layer; an inner electrode member which is disposed at a given clearance from the annular electrode member within the center opening of the annular electrode member and is fixed onto the mounting surface through the adhesive layer; and an outer electrode member which is disposed at a given clearance from the annular electrode member outside of the annular electrode member and is fixed onto the mounting surface through the adhesive layer, wherein the chuck main body, the inner electrode member, and the outer electrode member constitute a first electrode, and the annular electrode member constitutes a second electrode.

In the present invention, the chuck main body may include a mounting surface onto which an annular electrode member, an inner electrode member, and an outer electrode member can be mounted, and the configuration of the mounting surface can be identical with the configuration of a general bipolar electrostatic chuck. For example, a flange may be disposed on an outer peripheral surface of the chuck main body so that the electrostatic chuck can be detachably mounted onto a semiconductor manufacturing device.

Also, in the present invention, an annular electrode

member that is fixed onto the mounting surface of the chuck main body through an adhesive layer may be formed in an annular shape having a center opening, and the configuration of the annular electrode member can be formed in correspondence with the size or the configuration of a sample to be absorbed. In other words, because the annular electrode member constitutes the second electrode in the bipolar electrostatic chuck according to the present invention, the configuration and the area of the annular electrode member can be designed in such a manner that the electrostatic adsorptive force to the sample can be exhibited optimally. For example, in the case where the sample to be absorbed is a circular sample such as the semiconductor wafer, it is preferable that the configuration of the annular electrode member is a toric electrode member in which both of the outer peripheral configuration and the center opening configuration are circular. For example, in the case of the electrostatic chuck that holds a liquid crystal glass substrate that is generally rectangular or square, it is preferable that the annular electrode member is formed of a square annular electrode member in which both of the outer peripheral configuration and the center opening configuration are square.

CLAIMS

1. (After amended) A bipolar electrostatic chuck, comprising:

a chuck main body having a mounting surface;

an annular electrode member which is formed in an annular configuration with a center opening and is fixed onto the mounting surface;

an inner electrode member which is disposed at a given clearance from the annular electrode member within the center opening of the annular electrode member and is fixed onto the mounting surface; and

an outer electrode member which is disposed at a given clearance from the annular electrode member outside of the annular electrode member and is fixed onto the mounting surface,

wherein, at the time of assembling, the annular electrode member, the inner electrode member, and the outer electrode member are fixed onto the mounting surface through an adhesive layer, respectively, the inner electrode member and the outer electrode layer constitute a first electrode, and the annular electrode member constitutes a second electrode, and after use, the annular electrode member, the inner electrode member, and the outer electrode member can be separated from the mounting surface.

2. The bipolar electrostatic chuck according to claim 1, wherein the chuck main body constitutes the first electrode together with the inner electrode member and the outer electrode member.

3. The bipolar electrostatic chuck according to claim 1 or 2, wherein the mounting surface of the chuck main body has an outer convex portion for positioning the outer electrode member in a heightwise direction with respect to the mounting surface and/or an inner convex portion for positioning the inner electrode member in the heightwise direction with respect to the mounting surface.

4. The bipolar electrostatic chuck according to claim 1 or 2, wherein positioning pins that position the inner electrode member, the annular electrode member, and the outer electrode member in a horizontal direction with respect to the mounting surface are disposed between the chuck main body, and the inner electrode member, the annular electrode member, and the outer electrode member which are fixed onto the mounting surface of the chuck main body through the adhesive layer, respectively.

5. The bipolar electrostatic chuck according to claim 1 or 2, wherein at least one of the inner electrode member, the annular electrode member, and the outer electrode member which are fixed onto the mounting surface of the chuck main body through the adhesive layer is fixed onto the mounting surface of the chuck main body in a complementary configuration with each other.

6. The bipolar electrostatic chuck according to claim 1 or 2, wherein the chuck main body and the annular electrode member have interposed therebetween a positioning spacer for positioning the annular electrode member in the heigthwise direction with respect to the mounting surface.

7. The bipolar electrostatic chuck according to claim 1 or 2, wherein the inner electrode member, the annular electrode member, and the outer electrode member are made of pure aluminum.